

TOUCH PANEL AND DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to touch panels and display devices.

[0003] 2. Description of the Related Art

[0004] Conventionally, touch panels mounted on display devices such as LCDs (Liquid Crystal Displays) have been transparent touch panels that input control signals through operations with a pen or a finger in accordance with displayed information. Among those transparent touch panels, there are SAW touch panels. In a SAW touch panel, surface acoustic wave that is propagated on a glass surface is utilized as a means of detecting touched locations.

[0005] Japanese Unexamined Patent Document 2002-222041 (hereinafter referred to as Patent Document 1) discloses the conventional SAW touch panel. The touch panel device disclosed in Patent Document 1 is formed with a glass substrate, and a touched location is detected by spotting an interrupted location of the SAW being propagated on the surface of the glass substrate. Accordingly, the most advantageous features of this touch panel device are that the light transmittance is high and that the screen of the display device is not damaged. Also, as the operation area is a solid glass surface, scratches are not easily made. Accordingly, the durability of this touch panel device is higher than that of a touch panel device of any other type.

[0006] However, as the touch panel device disclosed in Patent Document 1 is formed with only one glass plate, the shock resistance is poor. Particularly, in a case where the glass thickness is reduced to produce a thin device, the glass substrate can be easily broken even by small impact. Also, when a drop of water or oil adheres to the glass surface, the propagation of SAW is interrupted, resulting in an erroneous input.

[0007] So as to solve the above problems, a touch panel device disclosed in Japanese Patent Publication No. 3010669 (hereinafter referred to as Patent Document 2) has been developed. The touch panel device disclosed in Patent Document 2 has a transparent film placed over a glass substrate, with spacers being interposed in between. In this structure, the transparent substrate on which surface acoustic wave is being propagated is exposed. Thus, a scratch or a drop of water cannot adversely affect the SAW propagation characteristics.

[0008] In the touch panel device disclosed in Patent Document 2, the transparent film is placed over the glass substrate on which SAW is being propagated, with the spacers being interposed between the transparent film and the glass substrate. However, in a case where the touch panel device is employed in a compact, thin mobile device, the energy of propagated SAW is so small that a large propagation loss is caused at the spacers formed on the glass substrate. As a result, accurate location detection cannot be carried out.

SUMMARY OF THE INVENTION

[0009] It is therefore an object of the present invention to provide a touch panel and a display device in which the above disadvantages are eliminated.

[0010] A more specific object of the present invention is to provide a touch panel and a display device that can perform accurate location detecting operations.

[0011] The above objects of the present invention are achieved by a touch panel comprising: a transparent substrate on which surface acoustic waves are propagated; a transmission/reception unit that is formed in peripheral regions on the transparent substrate, each two of the peripheral regions facing each other, and transmit and receive the surface acoustic waves; a detecting unit that detects the location of an object touching a predetermined operation area; and a sheet member that faces the transparent substrate, with a space layer being interposed in between, and has a plurality of first protrusions formed on a substrate-facing surface of the sheet member, which surface faces the transparent substrate, the substrate-facing surface of the sheet member being not brought into contact with the transparent substrate when an object does not touch the operation area, and the substrate-facing surface of the sheet member being brought into contact with the transparent substrate when the object touches the operation area.

[0012] The above objects of the present invention are also achieved by a display device comprising: a liquid crystal panel; and a touch panel that is mounted on the outer surface of the liquid crystal panel, the touch panel including: a transparent substrate on which surface acoustic wave is propagated; a transmission/reception unit that is formed in peripheral regions on the transparent substrate, each two of the peripheral regions facing each other, and transmit and receive the surface acoustic wave; a detecting unit that detects the location of an object touching a predetermined operation area; and a sheet member that faces the transparent substrate, with a space layer being interposed in between, and has a plurality of first protrusions formed on a substrate-facing surface of the sheet member, which surface faces the transparent substrate, the substrate-facing surface of the sheet member being not brought into contact with the transparent substrate when an object does not touch the operation area, and the substrate-facing surface of the sheet member being brought into contact with the transparent substrate when the object touches the operation area, and the sheet member being a polarizing plate.

[0013] The above objects of the present invention are also achieved by a display device comprising: an organic EL display panel; and a touch panel that is mounted on the outer surface of the organic EL display panel, the touch panel including: a transparent substrate on which surface acoustic wave is propagated; a transmission/reception unit that is formed in peripheral regions on the transparent substrate, each two of the peripheral regions facing each other, and transmit and receive the surface acoustic wave; a detecting unit that detects the location of an object touching a predetermined operation area; and a sheet member that faces the transparent substrate, with a space layer being interposed in between, and has a plurality of first protrusions formed on a substrate-facing surface of the sheet member, which surfaces faces the transparent substrate, the substrate-facing surface of the sheet member being not brought into contact with the transparent substrate when an object does not touch the operation area, and the substrate-facing surface of the sheet member being brought into contact with the transparent substrate when the object touches the operation area.